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ABSTRACT

This booklet contains proceedings of the Fourth Conference of the University/Urban Schools National Task Force. The conference was held to present information about four programs designed to help high school students to sharpen their reasoning skills. Criteria for program development state that: (1) the program can be taught to teachers in a relatively short time; (2) the program has available materials for use by students; (3) the program has a balanced approach to the treatment of content and verbal operations and processes; (4) the program can be integrated into the current organizational framework of high schools; and (5) research evidence exists concerning the effectiveness of the program in enabling students to reason well. The four programs so designed are described in the following reports: (1) "Instrumental Enrichment: Strategy for Cognitive and Academic Improvement," by Frances R. Link; (2) "Integrating Thinking and Reasoning Abilities Within the Curriculum," by Mary Meeker; (3) "Strategic Reasoning," by Howard Citron; and (4) "The Direct Teaching of Thinking as a Skill," by Edward de Bono. (Author/WAM)

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PROCEEDINGS:

The Fourth Conference of the
University Urban Schools National Task Force

The Fourth R: Reasoning

November 11 & 12, 1982
San Juan, Puerto Rico

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Edited by Richard M. Bossone

Center for Advanced Study in Education
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INTRODUCTION

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The Fourth Conference of the University/Urban Schools National Task Force met to provide its members with information about four programs dealing with reasoning. To aid in the structuring of the presentations and in the evaluation of these programs, a set of five criteria was developed. The criteria are as follows:

1. The program can be taught to teachers in a relatively short time.
2. The program has available materials for use by students.
3. The program provides a balanced approach to the treatment of content and mental operations or processes.
4. The program can be integrated into the current organizational framework of high schools (e.g., courses organized around subject matters).
5. Research evidence exists concerning the effectiveness of the program in enabling students to reason well.

Following the opening remarks and introductions, Ms. Frances Link described Reuven Feuerstein's Instrumental Enrichment program. Next, Drs. Mary and Robert Meeker discussed their application of J. P. Guilford's Structure of the Intellect Model. Mr. Howard Citron, representing Innovative Sciences, Inc., highlighted the key features of the Strategic

Reasoning program. Finally, Count Michael de Saint-Arnaud engaged conference participants in a series of exercises designed to help them understand the Cognitive Research Trust (CoRT) program.

If one compares the four programs discussed at the Conference, one noteworthy similarity emerges: that virtually all students can learn to reason. It was agreed by all that the vast majority of learning problems experienced by students are not genetically based, the result of inadequate knowledge, or the result of negative feelings and emotions experienced by the students. Rather, the majority of learning problems are attributed to the lack of appropriate cognitive structures and functions, that is, ineffective and inefficient mental operations and processes. Finally, the view of the learner underlying all four programs is the same: the learner must be actively engaged in the process of learning if he or she is to learn. The learner cannot be a passive recipient of instruction, no matter how "good" that instruction is.

Despite similarities of the four programs several distinctions are worth noting. The major distinctions occur in four areas or dimensions: 1) the content/mental process relationship, 2) the major focus of the program in terms of specific reasoning skills, 3) the role of the teacher in the program, and 4) the time needed for the completion of the program. A comparison of the program on each of these dimensions is shown in Table 1.

TABLE 1

A COMPARISON OF FOUR REASONING SKILLS PROGRAMS
ON SELECTED DIMENSIONS

Dimension	Instrumental Enrichment (IE)	Structure of the Intellect-Learning Abilities (SOI-LA)	Strategic Reasoning (SR)	Cognitive Research Trust (CoRT)
Content/ Mental Process Relationship	Mental processes largely independent of academic content	Mental processes prerequisite to academic content acquisition	Mental processes integrated with academic content	Mental processes independent of academic content
Major Focus-- Specific Reasoning Skill	Forming Relationships	Memory, Comprehension, and Evaluation	Analysis	Perception
Teacher Role	Questioner/ Discussion Leader/ Clarifier	Ensure students understand task; monitor student work	Moderator provides framework for students	Explain task; "work a watch, ring a bell"
Time Needed	2 to 3 Years (1 period lessons; 2 to 5 days a week)	2000 Tasks (30-minute lessons; twice a week)	35-60 hours (1 hour per week)	2 Years (60 lessons; each lesson 35 to 70 minutes)

Content/Mental Process Relationship

In two of the programs, IE and CoRT, the mental processes are treated virtually independent from academic content. In the IE program, visual displays are used extensively in the teaching of the mental processes. In the CoRT program, the student is taught to make use of whatever knowledge

he or she already possesses. Both of these programs tend to assume that the student will transfer newly acquired reasoning skills to academic areas.

In contrast, the SOI-LA and SR programs emphasize the relationship between academic content and mental processes but do so differently. The SOI-LA program helps students develop mental processes that are prerequisite to success in reading, writing, and mathematics. Different mental processes are hypothesized to be prerequisite to different academic content areas. The SR program, on the other hand, uses reading and mathematics content to teach a set of six reasoning skills.

Major Focus of Program

The four programs differ somewhat in the type of reasoning skills that are believed to be of primary importance. Two programs, IE and SR, are similar in emphasizing the student's ability to form relationships; the emphasis in the SR program is on analytical reasoning. These programs have similar emphases because analytical reasoning is one means of forming relationships.

The primary focus or emphasis of the other two programs is quite different from the IE and SR programs. The SOI-LA program emphasizes three abilities or skills: memory, comprehension, and evaluation. The CoRT program, on the other hand, emphasizes perception, a pre-operational skill. This emphasis on perception is based on the assumption that the situation and relevant information must be adequately perceived before it can be appropriately operated on or processed.

Teacher Role

The role of the teacher in each of the four programs is quite different. In three of the programs, SOI-LA, SR, and CoRT, the teacher gives instructions, moderates, and monitors the students. The teacher is responsible for ensuring that each task is clear to the students, checking student progress, and helping students experiencing difficulty in performing the task. The role of the teacher in the IE program is quite different. In this program, the teacher actively leads classroom discussion, poses questions requiring students to use reasoning skills, and directs the flow of the discussion, by clarifying and expanding on students' responses to questions.

One comment seems appropriate regarding the relationship between the role of the teacher and the available program materials. The need to stimulate and engage the learner in the process of learning would seem critical to the success of all four programs. In three of the programs, the responsibility for stimulating and engaging students in learning resides in the materials that have been developed. In contrast, the responsibility of stimulating and engaging students in the learning process in the IE program belongs to the teacher.

Time Needed

The problem of comparing the time needed for students to complete each program is more difficult than the previous comparisons. Several reasons can be given for this difficulty. First, time is expressed differently in each program. Some programs talk of lessons, some do not;

some programs suggest an optimal number of days per week, others do not. Furthermore, when the programs do discuss the issue of time, they do not distinguish between the time needed to complete the total program and the time needed to implement what may be termed the "minimally acceptable program."

Based on the kind of information presented during the Conference, the following generalizations can be offered. Each of the programs would require somewhere between one and three years to be implemented completely. The common denominator among the programs seems to be approximately two years. Part of the reason for this seemingly long period of time stems from the fact that the program is implemented only a certain number of days per week and hours per day. The IE program, for example, is offered from two to five days per week in lessons lasting one class period. The SOI-LA program is divided into 30 minute lessons which are presented to students approximately twice a week. Similarly, the SR program requires approximately one hour per week. Finally, the CoRT program contains 60 lessons, each ranging from 35 to 70 minutes, with no suggestion as to the number of times per week during which the program should be used.

In summary, the differences among the programs are theoretical (as in the relationship between content and mental processes), educational (as in the major focus or emphasis of the program and the teacher's role in implementing the program), and practical (as in the amount of time needed to properly implement the program as designed).

All of these differences should be considered when identifying a reasoning skills program which is best suited to the school organization, teachers, students, and overall goals of the participating school districts. In fact, the readers of these Proceedings may identify additional dimensions along which these programs can be compared. As one reads these Proceedings, several questions should be kept in mind. First, what is the best way of integrating reasoning skills with subject areas? Second, do not different subject areas demand or reinforce certain ways of reasoning? The third question concerns whether or not reasoning can be defined exclusively by a set of discrete reasoning skills.

These questions are not meant to downplay the importance of the work completed by the developers of the four programs described in these Proceedings. Rather, the questions are intended to suggest that a thoughtful analysis of the assumptions, constraints, and evaluations of such programs is critical. If public schools are to have an impact on the reasoning capabilities of their students, the best program for teaching reasoning must be developed. To this end, an evaluation design is being prepared and will be presented and discussed at the Fifth Conference of the University/Urban Schools National Task Force.

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INSTRUMENTAL ENRICHMENT: STRATEGY FOR COGNITIVE AND ACADEMIC IMPROVEMENT

Frances R. Link
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What lies behind a student's failure to think? All too often we attribute his inability to perform a given operation to lack of knowledge of the principles involved or, worse, to a low intelligence that precludes his understanding of those principles. What is overlooked is that the specific deficiency may reside not in the operational level or specific content of the child's thought processes but in the underlying functions upon which successful thinking depends.

This distinction is crucial to any valuable understanding of a student's corrective needs, which should take into account not only what he cannot do but why he cannot do it. Consider for a moment a problem requiring the mental classification of objects or events. Its solution necessarily involves subordinate mental functions such as systematic and precise data gathering, the ability to deal with two or more sources of information simultaneously, and the comparison of objects or events to be classified. A student incapable of performing and applying these prerequisite operations can hardly be expected to perform the overall task. Clearly, if teachers fail to locate the specific source of the child's cognitive weakness, corrective action in this area will suffer.

Improving the overall cognitive performance of the low-achieving adolescent demands a broad-scale strategy of intervention whose focus is not any specific skills or subject, but rather the process of learning itself. Instrumental Enrichment is such a program: a direct and focused attack on those mental processes which through absence, fragility, or inefficiency are to blame for poor intellectual or academic performance.

The core of the Instrumental Enrichment program is a three-year series of problem-solving exercises which are grouped in fourteen areas of specific cognitive development. They are called instruments rather than lessons because in themselves they are virtually free of content. Their purpose is to serve as the means or vehicle for cognition-oriented interaction between teacher and students. Each instrument's true goal is not the learner's acquisition of information but the development, refinement, and crystallization of those functions* prerequisite to effective thinking. In terms of behavior, Instrumental Enrichment's ultimate aim is to transform the retarded performer, to alter his characteristically passive and dependent cognitive style to that of the active, self-motivated, independent thinker. Instrumental Enrichment has been developed by Reuven Feuerstein, an Israeli clinical psychologist.

The six major goals of Instrumental Enrichment are:

1. To correct weaknesses and deficiences in cognitive functions.
2. To help students learn and apply the basic concepts, labels, vocabulary, and operations essential to effective thought.

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* See Attachment 1

3. To produce sound and spontaneous thinking habits leading to greater curiosity, self-confidence, and motivation.
4. To produce in the student increasingly reflective and insightful thought processes.
5. To motivate students toward task-oriented abstract goals, as opposed to objectives of impulsive self-gratification.
6. To transform the poor learner from a passive recipient and reproducer of information into an active generator of new information.

Why Do Students Fail?

Numerous causes are suggested to explain poor cognitive performance, ranging from heredity to environment. At one extreme Arthur Jensen (1969, 1973) holds that mental ability is largely determined by genetics and so is inaccessible to substantial modification. He has proposed a dichotomous model of intelligence in which humanity is divided according to genetic endowment: those people whose capacities are limited to simple mental acts of an associative and reproductive nature; and those able to use complex transformational, operational, and abstract processes. Jensen suggests we accept the "limits" imposed by heredity and adjust educational goals downward for those with "low intelligence." This is the position of defeat.

At the opposite extreme, we encounter the notion of fantasy that the retarded performer's failure can be traced to unreasonable demands imposed by an insensitive and alien school system. This theory, the "cultural difference" position, implies that merely altering the student's learning

environment will produce the desired changes and eliminate poor performance. This gross oversimplification fails to recognize that deficient cognitive functioning is neither culture-bound nor limited to the classroom, occurring as it does in all manner of life situations. A student may master education's "three R's" yet still be incapable of adapting to new information, demands, and responsibilities both in school and later in life, for lack of the fourth: Reasoning.

Between these extremes lie a host of intermediate theories, all of which share the belief, either implicit or explicit, that the persistence of poor cognitive performance beyond childhood is a condition beyond remedy. All are fundamentally at variance with the goals and strategies of Instrumental Enrichment.

Retarded Performance: A Temporary State

In contrast, Instrumental Enrichment is firmly rooted in the concept of cognitive modifiability as the working channel for improving the underlying processes of thought. The program's essential aim is not merely remediation of specific behaviors, but basic structural changes that alter the individual's whole course of cognitive development.

One common misconception to be overcome is that retarded performance is an irreversible state. Sadly, the term "retardation" has come to imply that an individual's capacity for growth and development is fixed and immutable. Yet evidence is mounting that, except in the most severe cases of organic impairment, the human mind is open to modification at all ages and stages of development. The term "retarded performance," therefore, is meant to stress that what is retarded is no more than the individual's

manifest cognitive ability at the present time. It is not a label for any supposedly stable and immutable characteristic of his ultimate potential.

Although a pervasive state, retarded performance is neither permanent nor irreversible. Retarded performers do not make connections based on former experiences in learning. They do not spontaneously build relationships. They view the world and learning in an "episodic" manner. They do not seem to learn from direct exposure to experience. By changing the cognitive structure rather than selected dimensions of behavior, we can achieve a permanent, enduring, and stable state of capacity for improvement.

Cognitive Modifiability: To Adapt, To Survive

To understand what is meant by cognitive modifiability and why it is such a valuable human attribute, one must appreciate the difference between structural changes in cognitive development and other kinds of developmental processes. In the normal course of events, a child undergoes a series of changes. These may be of a maturational nature, such as the transition from crawling to walking; or they may result from exposure to specific sets of circumstances, such as learning a particular arithmetic operation or a foreign language.

Unlike development spurred by random experiences, structural changes reflect a person's entire manner of dealing with and responding to information and stimulation. Modifying this cognitive structure demands a particular kind of mediation or intervention by the trainer which renders the individual receptive and sensitive to sources of information and stimulation from which he would otherwise be incapable of benefiting.

Cognitive modification promotes continuous growth by opening the channels for adapting to the demands of life and the environment. The survival of any organism depends on its ability to respond, not to a constant, stable environment, but to situations and circumstances continually in flux. Ultimately, the Instrumental Enrichment curriculum attempts to provide the learner with the means for his survival in school and throughout life.

The Mind as a Container: Open or Closed?

Instrumental Enrichment's active modification approach contrasts sharply with the passive acceptance approach that concerns itself with adjusting external conditions to suit the limited abilities currently manifested by the retarded performer. A case in point is special education. Not only the modes of training but also its goals are based on so-called "realistic limits" indicated by current levels of functioning. The child's cognitive structure is deemed an immutable entity and so attempts to elicit change are kept within this presumed capacity. This approach sees the mind as a rigid container with predetermined limits to what it may contain. It is not viewed as the dynamic, elastic, and flexible system it is, with a capacity and structure that can change through adolescence and beyond, as the learner's latent functions encounter and interact with new stimulation.

At the heart of the matter lies the issue of whether the mind is an open or closed system. When intelligence is conceptualized in quantitative terms as a fixed product of ability that is constant through life, passive

acceptance of the present condition is the outcome. Attempts to modify an individual's course of development come to be regarded as futile, even unfair, because they demand the "impossible."

The common response is to confirm the observed low level of performance using tests specifically designed to measure such performance. The student's low achievement in school is confirmed by poor performance on tests, after which he is classified, labeled, and left at his current stage of functioning. This exercise in self-fulfilling prophesy, needless to say, holds devastating implications for the ultimate destiny of the student.

The Instruments: What They Do

The instuments provide sufficient material for one-period lessons given two to five days a week. Although a three-year sequence is recommended, the program may be implemented in two years, depending on the class curriculum and students' needs. Instrumental Enrichment is not intended to replace traditional content areas, but as a supplement to help students get the most out of all opportunities to learn and grow. The Instrument are tools for learning to learn. The goal is the development of higher mental processes, not minimum competencies.

First Year Curriculum

Organization of Dots

The aim of this initial instrument is to produce in the student the spontaneous ability to discern relationships among data which may not be clearly organized. Students find the relationships--shapes, figures, and

other attributes--among a field of dots, much the way one picks out constellations in the night sky. In this way they begin developing strategies for linking perceived events into a system yielding comprehensible information that can be a basis for understanding and logical response.

Orientation in Space I

This instrument promotes the creation of specific strategies for differentiating frames of reference in space, particularly with regard to the student's personal frame of reference. Left, right, front, back are the major concepts developed. It also helps illuminate the important differences between systems based on relative measures or quantities as opposed to those which deal in absolutes, and how strategies for dealing with each must adjust accordingly. The development of "point of view" in personal, political, and social relationships is the focus of bridging activities.

Comparisons

The spontaneous and efficient comparison of behaviors, ideas, and events is an ability crucial to ongoing cognitive development. This instrument, therefore, fosters precise perception, the ability to discriminate by attribute (equal/unequal, similar/dissimilar), and the judgment necessary to identify and evaluate similarities and differences.

Analytic Perception

This instrument addresses the ability to analyze component parts in order to find how they relate to each other as well as how they contribute to the overall character of the whole they compose. Students learn to

recognize how systematic analytical processes may be applied in a variety of ways to physical structure, to the different parts of an activity or operation, to the reasons through which an act or event is explained, and to the creation of logical propositions.

Second Year Curriculum

Categorization

In this instrument, students learn not simply how to sort objects or events, but the underlying principles and strategies for creating conceptual sets and categories, a vital prerequisite for higher mental processing. By finding the common attributes which go into the formation of categories, students develop the abilities to perceive, label, and compare, as well as to differentiate between relevant and irrelevant information.

Instructions

Instructions emphasizes the use of language as a system for both encoding and decoding operational processes on levels of varying complexity. By requiring students to read and carry out directions precisely, it promotes systematic, ordered thought and response. Exercises also focus on critiquing instruction, rewriting instructions to supply missing relevant data, and the creation of instructions and directions for others to follow.

Temporal Relations

This instrument addresses chronological time, biological time, and other temporal relations. Students learn to isolate the factors which go into evaluating or predicting outcomes--time, distance, velocity--and to find the interrelationships among those factors. Problems force students

to seek all relevant information, such as starting points, routes, distances, and terrain before attempting to compare and summarize, thus restraining impulsiveness and stressing the need for planning.

Numerical Progressions

This instrument promotes the ability to perceive and understand principles and formulas manifested in numerical patterns. By searching for the principles involved in ascending and descending numerical progressions, students learn to establish relationships among events and to discover the rhythms by which relationships repeat themselves.

Family Relations

While the title of this instrument suggests the study of relationships among kin, its larger goal is the promotion of a clearer understanding of how individual roles in hierarchical organizations define the network of relationships that are encountered in daily life and work. In short, Family Relations helps bring into focus the complexity of relationships within the human family and in all hierarchical structures.

Illustrations

This is a collection of situational cartoons which present, in graphic form, problems that the student must perceive, recognize, and interpret. Its aim is to encourage a spontaneous awareness that a problem exists, the analysis of why it exists, and the projection of cause-and-effect relationships. Unlike other instruments, Illustrations needs not be taught sequentially but can be interspersed among other instruments as needed for assessing mastery or correcting specific operations.

Third Year Curriculum

Transitive Relations and Syllogisms

These two instruments, usually taught together, foster the higher level abstract and inferential thought for which the student has been prepared by mastery of earlier instruments. Transitive Relations deals with drawing inferences from relationships that can be described in terms of "greater than," "equal to," or "less than." In effect the student learns the rules governing transitive thinking and to connect separately presented statements by means of a common reference point. Syllogisms deals with formal propositional logic and aims of promoting inferential thinking based upon local evidence. The student learns the laws governing sets and their members as well as how to construct new sets by such operations as logical multiplication. In addition to formal syllogistic thought, the student learns to critique analytic premises and propositions.

Representational Stencil Design

One of the most advanced instruments in the program, Representational Stencil Design, calls into play a broad range of higher level thought processes addressed in previous instruments. Completing its tasks requires an intricate series of steps: analyzing a complex figure, identifying its components, then recreating the whole mentally, in color, shape, size, and orientation.

Orientation in Space III

This final instrument deals with spatial relations according to standard conventions: north, east, south, and west. It complements the

earlier instrument in spatial orientation by extending the student's understanding of relative positions from a personal orientation to the stable external system represented by the points of the compass. Personal and external orientations are integrated in a way that permits the student to use both simultaneously.

The Means: Mediated Learning Experience

The development of higher mental processes cannot be understood without the powerful adjunct concept of mediated learning experience. This refers to a particular kind of experience which, for all its technical-sounding name, is a familiar and integral part of growing up for most of us.

In its earliest manifestations, mediated learning experience is the way a parent and later the teacher instructs a child and transmits cultural elements. Guided by intentions, culture, and emotional investment, the "mediating" agent selects and organizes a child's world of stimuli toward a particular goal of behavior attitude. As a result of such mediation, a child acquires the learning sets and operating structures for mentally organizing, processing, and acting upon information gathered from internal and external sources.

Mediated learning experience may be viewed as the means by which nascent, elementary cognitive sets and habits are transformed into the bases for effective thinking. Consequently, the earlier and the more a child is subjected to mediated learning experience, the greater will be his capacity to efficiently perceive, understand, and respond to

information and stimulation in and out of school. The less mediation the child experiences, both in quantity and quality, the less prepared he will be for school and life.

If this concept is accepted, one can readily see that Instrumental Enrichment is developing increasing evidence that it can substitute for early mediated learning experience. By interposing the Instrumental Enrichment program, the teacher can facilitate the organization and transmission of information at increasingly complex, abstract, and efficient levels of functioning. Mediated learning experience of this kind hastens the development of the prerequisite cognitive structures that enable a human being to learn and grow. At stake is not merely the acquisition of particular skills or abilities, but the opportunity to radically divert the adolescent's stubborn course of failure and to institute a pattern of growth and development. In summary, Feuerstein's concept of intelligence lies not in its measured product but rather in its active construction.

Teacher Training in Instrumental Enrichment

Whatever the particular focus of an instrument, its larger purpose is always the further development of the student's conscious thought processes and his or her discovery of their practical applications in and out of school. In this effort, the teacher plays the crucial role.

To perform this role, the teacher requires special training in Instrumental Enrichment's basic precepts, materials, and teaching strategies. The teacher must learn how to extract the thinking processes

and principles from an instrument and how to help students learn to apply them. The teacher, moreover, must focus the educational experience set in motion by the exercises to help the student understand in cognitive or problem-solving terms what his or her performance means in order to overcome the frustration and alienation engendered by past failures to learn or limited opportunity to think on higher cognitive levels.

Teacher training thus involves five days or 45 hours of in-service annually, plus "on-the-job" use of exercises in the classroom, if possible, while training is in process. Training programs are custom designed to fit the in-service schedules of school systems.

Training concentrates on these three areas:

1. Understanding and acceptance of Instrumental Enrichment's fundamental theories and concepts.
2. Mastery in the classroom use of the instruments themselves by learning to plan lessons to focus on the six sub-goals of Instrumental Enrichment.
3. Special techniques for bridging, developing insight, and applying cognitive processes to specific subject matter and to life experience.

School Effectiveness Data

Atlanta, Georgia

The Instrumental Enrichment program is currently being implemented in grades 5, 6, and 7 in selected Title I schools in Atlanta, Georgia. Instrumental Enrichment was chosen three years ago to supplement mathematics

instruction five periods a week. Using the Instrumental Enrichment approach, Title I teachers sought to identify the specific cognitive deficiencies which Instrumental Enrichment is intended to mediate and to focus instruction toward the correction of deficient cognitive functions. Also, the improvement of mathematics test scores for upper elementary grades was explicitly stated as part of this project.

Test results, reported by the Division of Evaluation and Data Processing in Atlanta, substantiate the success of Instrumental Enrichment as an intervention strategy and program. Achievement gains for Title I Instrumental Enrichment (IE) students were compared to achievement gains for Title I Eclectic Approach (EA) students and also to the general population in the Atlanta Public Schools. The student achievement was measured for the years 1978-79 and 1980-81 (first and third years of Instrumental Enrichment). An analysis of CAT (California Achievement Test) comparisons during the third year of the intervention shows that the achievement gains of students participating in the Instrumental Enrichment program exceeded those of each of the comparison groups. The average gain for the 803 IE students was 1 year and 6 months for 1980-81 school year, as compared with the average 1 year and 2 months gain by the 5,034 Title I EA students, and the 1 year and 3 months gain by the 15,299 general student population. Seven Instrumental Enrichment schools reported an average gain exceeding two years growth.

In January, 1982, teachers responded to three questions:

I. What skills have your students developed which you think have improved their performance in mathematics?

1. IE takes the shame out of being in Title I. Students feel they can do things that non-Title I students cannot do.
2. Students reflect more careful use and systematic approach to solutions of problems.
3. Students demonstrate an ability to define and use new vocabulary.
4. Students show greater awareness of math in real life.
5. Students demonstrate increased ability to think through a problem as it applies to math and to everyday life.
6. Students participate more in oral discussions.
7. Students reflect ability to make assumptions and predictions.
8. Students have improved ability to see relationships.
9. Students are more enthused about work and assignments.
10. Students have improved work habits and increased ability to use alternative strategies in problem-solving.

II. How have your experiences in Instrumental Enrichment affected your view of teaching and learning?

1. I have increased ability to plan, implement, and evaluate each child's work according to individual needs and interests.
2. I have more patience with and more awareness of a child's difficulties in doing tasks.
3. There is more enjoyment in teaching math than before and

development of better questioning strategies to achieve problem-solving.

4. I have greater ability to give directions clearly.

III. Describe an incident or a student that illustrates what Instrumental Enrichment is achieving.

1. Many students have become independent and experience a feeling of importance; they have served as helpers and peer tutors.
2. Students often "have to be forced" to move on to other classes at the end of IE period.
3. Students are conscious of need for planning to avoid making errors in problem-solving.
4. Many students are expressing more positive attitudes toward learning math.
5. Evidence of transfer to regular class work was described when a student related "Analytic Perception" tasks to fraction bars.
6. Students demonstrate greater efficiency in following written and oral instructions.
7. A former Instrumental Enrichment student who has dropped out of high school said on a recent visit to my class, "I would go back if they had something to do like we did in your 'IE' class."

Ann Arbor, Michigan

Instrumental Enrichment was first used on a pilot basis in 1979-80 with

35 seventh graders who had been referred to a Language Laboratory class because they were two or more years below grade level on a Nelson Reading Skills Test. At the end of one year in the program, 50 percent of the students tested out of the program, a situation which had not occurred before.

Another group of 34 students received conventional reading improvement instruction in 1979-80 and gained an average of three months in reading achievement. In 1980-81, this same group of students was placed in an Instrumental Enrichment program and gained an average of one year and five months in reading achievement.

New York City: A Teacher's Report

In 1980, New York City launched a two-year pilot project with Instrumental Enrichment, involving 40 teachers and administrators and 900 students at the intermediate school ages (10-13 years old). A complete report is in the process of being developed by the New York City Board of Education Department of Evaluation. One teacher in June, 1982, sent the following report of results with Instrumental Enrichment students in Mahalia Jackson Intermediate School #391 in Brooklyn, New York:

> "I am most happy to report to you these wonderful results. Many students achieved 3-4 years reading progress during their experience in the two-year pilot Instrumental Enrichment Program. In fact, 11 of our 26 eighth graders are now at tenth grade level or better. Some of this progress can be attributed to normal growth and excellent team-teaching; however, given the remarkable results, it is more than reasonable to conclude that the Instrumental Enrichment regimen played a pivotal role. Moreover, the math results show that 16 of the original pilot 26 youngsters are now functioning at High School level...."

United Kingdom, England: Interim Report

In 1980, the Schools Council, the Organization of Economic and Cultural

Development (OECD) and five Local Authorities (LEA) agreed to mount a two-year study of Instrumental Enrichment teaching in UK schools. Each LEA selected two to four institutions to take part in the study.

Instrumental Enrichment is being taught in seventeen establishments in inner London, Somerset, Coventry, Manchester, and Sheffield Education Authorities. One college of further education is involved, together with an equal number of special schools and comprehensive high schools.

Experiences and Reports of Effectiveness

Local evaluators from universities were asked to visit each class at least once every term and to submit a record of observations to the Schools Council. Evaluators and LEA coordinators were also asked to write short progress reports early in 1982, and records were kept of discussions. A cumulative record of experience, therefore, has been available to Schools Council coordinators and provides the basis of this interim review.

Institutions organized IE teaching in a wide range of different ways. Some offered short intensive courses; others employed extended light programs, and in consequence, pupils' weekly contact time with IE varied widely. Some teachers worked alone, others benefited from ancillary help and team-teaching techniques. Often, particularly in the special schools, teachers taught IE to classes with whom they spent a large part of the week. Pupils receiving IE teaching were mainly between 11 to 15; most were retarded performers and some had behavior problems.

There was a strong general impression that pupils, including retarded performers, were benefiting from IE. The evidence was mixed, but largely

positive and in some cases extremely so. Evaluators' observations have frequently shown pupils enjoying lessons--interested, motivated, and increasing in self-confidence. Pupils were felt to be learning in most lessons observed and one evaluator remarked on the apparent ability of even seriously handicapped pupils to keep up with the group. In some cases, teachers reported improvements in attendance and behavior and noted increases in pupils' spans of concentration.

Some teachers reported improvements by IE pupils in other subjects and commented on better attitudes and study skills. Others noted increased concern for accuracy and planning; pupils were described as less impulsive and concerned to check work more carefully. In two schools, pupils joined examination courses as a result of improvements attributed to IE. Of course, one must recognize that the stimulus and extra attention associated with innovation is always likely to produce positive results, but evidence now accruing suggests that momentum is being maintained and gains are lasting.

Teachers have inevitably needed time to gain confidence with the new materials and teaching strategies. Some are not yet fully adept at handling discussions and relating work covered in IE to other subjects and contexts (bridging). Some bridging still tends to be rather ad hoc and limited.

However, there is evidence that the materials have had a significant effect on teachers. Many are spending much time preparing IE lessons and, in consequence, are thinking harder about their teaching strategies. Many also say they have revised upwards their expectations of pupils; in the

words of one teacher:

> A number of children have shown insights, used language or solved problems that I would previously have thought unlikely.

In summary, it can be said that IE has been generally well received by teachers and pupils in the UK. The work has not been without its problems, but many of these have organizational roots that would apply to any curriculum innovation. In 1983, more evidence will be available on which to base a fuller appraisal of the program. In the meantime, one closing comment from an evaluator may give something of the flavor of the work:

> The children were consciously thinking problems through...the teacher wondered whether working with the materials had alerted her to the nature of problems and changed the way she taught.

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ATTACHMENT 1

INSTRUMENTAL ENRICHMENT COGNITIVE FUNCTIONS

I. Gathering all the information we need (Input)

1. Using our senses (listening, seeing, smelling, tasting, touching, feeling) to gather clear and complete information (clear perception).
2. Using a system or plan so that we do not skip or miss something important or repeat ourselves (systematic exploration).
3. Giving the thing we gather through our senses and our experience a name so that we can remember it more clearly and talk about it (labeling).
4. Describing things and events in terms of where and when they occur (temporal and spatial referents).
5. Deciding on the characteristics of a thing or event that always stays the same, even when changes take place (conservation, constancy, and object permanence).
6. Organizing the information we gather by considering more than one thing at a time (using two sources of information).
7. Being precise and accurate when it matters (need for precision).

II. Using the information we have gathered (Elaboration)

1. Defining what the problem is, what we are being asked to do, and what we must figure out (analyzing disequilibrium).
2. Using only that part of the information we have gathered that is relevant, that is, that applies to the problem and ignoring the rest (relevance).
3. Having a good picture in our mind of what we are looking for or what we must do (interiorization).
4. Making a plan that will include the steps we need to take to reach our goal (planning behavior).
5. Remembering and keeping in mind the various pieces of information we need (broadening our mental field).
6. Looking for the relationship by which separate objects, events, and experiences can be tied together (projecting relationships).
7. Comparing objects and experiences to others to see what is similar and what is different (comparative behavior).
8. Finding the class or set to which the new object or experience belongs (categorization).
9. Thinking about different possibilities and figuring out what would happen if we were to choose one or another (hypothetical thinking).
10. Using logic to prove things and to defend our opinion (logical evidence).

III. Expressing the solution to a problem (Output).

1. Being clear and precise in our language to be sure that there is no question as to what the answer is. Putting ourselves into the "shoes" of the listener to be sure that our answers will be understood (overcoming egocentric communication).
2. Thinking things through before we answer instead of immediately trying to answer and making a mistake, and then trying again (overcoming trial-and-error).
3. Counting to ten (at least) so that we do not say or do something we will be sorry for later (restraining impulsive behavior).
4. Not fretting or panicking if for some reason we cannot answer a question even though we "know" the answer. Leaving the question for a little while and then, when we return to it, using a strategy to help us find the answer (overcoming blocking).

INTEGRATING THINKING AND REASONING ABILITIES WITHIN THE CURRICULUM

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American educators in accepting a democratic truism that all children are equal and can be mass-educated have learned through painful failures that this is not, nor has it ever been the case. They also have learned that though they strive for average growth in grade expectancies, this concept of average is an artifact of testing.

We now must face the reality that if all children who come to school are not equal and if average is not a reality, then educators must help students benefit from all learning opportunities. One way to accomplish this task is to equip students with the necessary intellectual skills for learning traditional subject matter presented in fairly traditional ways.

A Model for Curriculum

Guilford's Structure of Intellect (SI) model has provided a curriculum paradigm for developing what are termed the Structure of the Intellect-Learning Abilities (SOI-LA) diagnostic tests. The tests have been nationally normed. Furthermore, programs of curriculum materials and activities have been developed to meet the thinking, reasoning, and intellectual needs of students identified by the tests.

Guilford hypothesized three dimensions of intellectual abilities. The first dimension is the "operation" dimension. Five operations have been postulated: Cognition (C), Memory (M), Evaluation (E), CoNvergent

Production (N), and Divergent Production (D). The second dimension is the material being dealt with. Three types of content have been identified: Figural (F), Symbolic (S), and SeMantic (M). The third and final dimension has been labeled "product" and refers to the way in which content is organized. Six types of products are: Units (U), Classes (C), Relations (R), Systems (S), Transformations (T), and Implications (I). Each specific ability can be identified by three letters. The first refers to the operation; the second, the content; the third, the product. For example, cognition (operation) of figural (content) units (product) is abbreviated as CFU.

The difficulty with SI terminology is well expressed in Lewis Carroll's Alice in Wonderland: the words do not always mean what they say. To translate the SI trigrams into meaning requires atleast one-half day of training. And to learn to apply the meanings to school curriculum requires another day of teacher training.

Problems with Children Entering Kindergarten

Approximately 60% of children entering kindergarten are not prepared for school entry. Specific abilities which allow these children to learn academic subject matter are often not yet developed or are underdeveloped. As a consequence, they enter school with real needs for training in another basic called intelligence other than training in reading, writing, and arithmetic. If learning is to take place, students must possess certain intellectual abilities upon entry to school. The major type of learning we require of our students, CoNvergent Production (N), defines one major

kind of intellectual ability. It is the ability to solve a problem where the answers are known. But convergent production usually does not occur unless the three abilities foundational to this level of functioning are present: Cognition or Comprehension (C), Memory (M), and Evaluation (E). These three abilities must be fostered if we are to expect children to succeed in kindergarten and beyond. Comprehension, memory, and evaluation, then, can be referred to as pre-learning abilities.

How Do Students Gain These Pre-Learning Abilities?

Anglo children tend to enter school prepared in the foundational intellectual abilities required for school learning. Minority children from minimal-English speaking families or from low income homes, however, rarely enter school prepared linguistically for the semantic curriculum they will encounter.

My research in applying Guilford's SI theory began in 1962. My application of his theory has been called the SOI which differs markedly from the SI. My application has identified developmental attributes previously unpredicted by the static model developed by Guilford through factor analytic methods.

Slowly and gradually from 1962 to 1974, investigations led me to identify and validate 26 of the 96 factored intellectual abilities hypothesized to be necessary for school learning. If taught, these 26 abilities do successfully prepare students in the cognitive processes needed for learning (ERIC EC 112882). These 26 factors led to the development of a pilot test conducted in 1973 and 1974 which gave rise

to the SOI-LA tests.

Differential learning patterns were found among Anglos, American and Canadian Indians, Mexican Americans, Hispanics, and Blacks. The minority children were found to score well on intellectual abilities different from those possessed by Anglo children. If these minorities are tested with the Binet and WISC tests (which are not based on a theory of human intellectual functions), minority students' individual strengths are minimally tested. Further, the result is excessively low I.Q. scores.

What is the Composition of Curriculum?

The traditional school day is primarily devoted to reading, social studies, language arts, science, and mathematics. The basic content of reading, social studies, and language arts is of a verbal nature, occupying from 75 to 80% of the school day and is dependent upon seMantic intellectual abilities. Major intelligence and achievement tests are also 75 to 80% dependent upon verbal abilities. Thus, the prediction of success in school learning from intelligence and achievement tests is fairly accurate. It should be pointed out parenthetically, that seMantic intelligence is a function of the left hemisphere of the brain.

Mathematics and some aspects of science are dependent upon the manipulation of abstract symbols. Thus the need for symbolic and figural intellectual abilities comes into play for the approximately 15% of the school day which is spent in arithmetic, math, or science.

Symbolic intelligence is a function of the right and mid-frontal hemispheres of the brain. Similarly, the mid-hemispheres and cross-over functions lean toward symbolic and figural thinking (used in activities such as arithmetic, notation systems, music, and foreign language learning). These subjects, however, occupy a minimal part of the school day. School, therefore, is devoted minimally to coursework dependent on Symbolic abilities and after the primary grades is almost void of coursework in which Figural experiences are taught.

The Analysis of the Dictionary of Occupational Titles, a United States Government publication, shows us that from 12 to 15 percent of jobs depend on a high level of verbal intelligence whereas approximately 80% depend on figural and symbolic abilities. The inverse proportions are obvious, but even if one philosophizes that schooling is not for the purpose of work competency, one needs to be concerned about the lack of "exercise and development" of the human brain which current and past traditional curriculums neglect. No matter which philosophical position one takes, it is clear that intellectual abilities required for learning, for living, and for work of any kind are not the same as those emphasized in schools.

What Needs to be Done to Avoid Continual Failure?

The abilities necessary for school success must be identified. As has been mentioned, twenty-six such prerequisite abilities have been identified from years of research. Twenty-two of these abilities are figural and symbolic; only four are verbal (CMU, CMR, CMS, and DMU). Those abilities necessary for academic success in reading and arithmetic

are identified and labeled in Table 1.

TABLE 1

ABILITIES IDENTIFIED AS BEING NECESSARY
FOR SUCCESS IN READING AND ARITHMETIC

READING (Foundational abilities):

____ CFU--Visual closure
____ CFC--Visual conceptualization
____ EFU--Visual discrimination
____ EFC--Judging similarities and matching of concepts
____ MSU (visual)--Visual attending
____ MSS (visual)--Visual concentration for sequencing

READING (Enabling skills):

____ CMU--Vocabulary of math and verbal concepts
____ CMR--Comprehension of verbal relations
____ CMS--Ability to comprehend extended verbal information
____ MFU--Visual memory for details
____ NST--Speed of word recognition

ARITHMETIC:

____ CFS--Constancy of objects in space (Piaget)*
____ CFT--Spatial conservation (Piaget)*
____ CSR--Comprehension of abstract relations*
____ CSS--Comprehension of numerical progressions
____ MSU (auditory)--Auditory attending
____ MSS (auditory)--Auditory sequencing
____ MSI--Inferential memory*
____ ESC--Judgment of arithmetic similarities
____ ESS--Judgment of correctness of numerical facts
____ NSS--Application of math facts
____ NSI--Form reasoning (logic)*

*pre-math abilities

Studies in California, New York, Texas, Arizona, Canada, Louisiana, and Florida have indicated that students who do not develop the 26 learning abilities fail regularly in school. Furthermore, these students fail in part because their teachers have no back up system or theory to remediate

these deficiencies in learning abilities. Studies also suggest that when teachers receive information relating to these deficiencies and when SOI modules keyed to these deficiencies are used by the teachers, these students do learn and do develop other intellectual abilities and thus achieve success in school. Furthermore, when learning strengths (or learning styles) based on information obtained from the SOI-LA are matched with SOI modules, students are more successful in school learning.

The "content" dimension of the SI model is most likely related to success in various subject areas. Although Figural (F), Symbolic (S), and SeMantic (M) map the hemisphere functions of the brain (and, as such, can be used to identify learning styles and preferences), these content typologies are also highly predictive of success in reading and mathematics. For example, most boys and most minority students are figural learners. Reading programs rarely teach to the Figural learner (the Gillingham method being an exception). Symbolic learners seem to do best with a phonetic system. SeMantic learners seem to do best with basal readers.

We cannot afford to continue teaching a curriculum without a theoretical basis for relating abilities to educational needs. Development of intelligence is indeed a basic for education and poses an issue for consideration in teacher training models.

Curriculums Which Train Required Intellectual Abilities for Successful Learning

The first SOI curriculum workbooks were written during 1963. Each exercise was based on a single SI ability. From 1963 to 1966, these exercises were placed in the field for testing to examine their utility

and validity. Several questions were asked concerning the validity of the workbooks and exercises. The questions and answers can be summarized as follows:

1. Did they, indeed, increase established intellectual abilities?

   Yes, intellectual abilities did increase as evidenced by SOI testing, a variety of achievement tests, and Binet and WISC tests.

2. Did they develop low abilities or even non-existent abilities?

   Yes, students with low abilities did develop the targeted abilities. Again, SOI testing, achievement, and intelligence tests were used to address this question.

3. Did the students enjoy them? Were the exercises age/grade appropriate?

   Exercises which were not perceived by teachers to be enjoyable (based on observation of students) were eliminated. Teachers also rated the exercises by grade level, and the sequencing of exercises was based on these ratings.

4. Did the exercises show predictive and construct validity for increased reading and arithmetic achievement as measured on standardized achievement tests?

   Yes, the abilities as taught did increase reading and arithmetic achievement even when the time devoted to SOI training decreased the amount of time spent in each of these subject matters. The SOI lessons decreased the amount of time devoted to reading and mathematics by approximately 60 minutes per week.

Current SOI Training Materials

Students who are motor learners and learn more quickly through their hands were found to need third dimensional materials for training SOI abilities. Learning center materials were designed, developed, and field tested for construct and predictive validity over a period of ten years.

In addition, the materials have been sequenced as to order of

presentation for the purpose of preparing intellectual abilities needed for 1) learning to read, 2) developing memory skills, and 3) conservation thinking in arithmetic where the theoretical constructs of Guilford and Piaget intersect.

There are five advantages to working with the Guilford theory:

1. Other major investigators of the acquisition of knowledge (such as Piaget, Montessori, and Bloom) fit within the SI theory.
2. When there is failure to learn, SOI sequencing provides a way of identifying the abilities that are poorly developed.
3. The theory enables us to develop appropriate materials and programs for the gifted.
4. Learning abilities can be identified which can aid in (or detract from) learning to read and learning to perform arithmetic operations.
5. The needs of "special education" students can be easily identified. Once the needs are identified, specific educational plans can be developed.

Levels of SOI Materials

As has been mentioned, the SOI Learning Center equipment is sequenced for preparing inner-city and non-advantaged preschool, primary, and special education students for learning. See Table 2 below.

TABLE 2

INTEGRATING THINKING AND REASONING ABILITIES*

For Competency in

	Reading and Language Arts, English	Arithmetic	Math	Writing	Science
SOI PROCESS & DIAGNOSTIC TEST** Preschool, K-2 Use this diagnostic test, 2 settings, to screen for special education and gifted.	Visual closure.....CFU** Visual conceptualizationCFC Vocabulary.....CMU Speed of word recognition.....NST Visual memory for details.....MFU Identifying similarities and differences.....EFU	Rote skills.....CSS Auditory attending...MSU-A		Copying eye-hand and motor integration...NFU	Verbal reasoning.....CMR Verbal sequencing and understanding instructions.....CMS
SOI-LA Forms A and B (2½ hours)***	The above abilities, plus: Verbal reasoning.....CMR Sequential comprehension.....CMS Judging similarities and matching concepts...EFC Visual attending.....MSU-V Visual concentration for sequencing....MSS-V	The above abilities, plus: Auditory sequencing.....MSS-A Judgment in arithmetic principles.....ESC Judgment of correctness of numerical facts.....ESS Application of math facts.....NSS	Constancy of objects in space.....CFS Spatial conservation..CFT Comprehension of abstract relations.....CSR Judgment in arithmetic principles.....ESC For algebra-all the above + NSI	Copying eye-hand and motor integration...NFU Ideational expression.....DFU Creative writing.....DMU	The above abilities, plus: Memory for implications.....MSI Deductive reasoning and logic.....NSI Comprehension of abstract relation.....CSR Identifying similarities and differences.....EFU
For intermediate and secondary **SPLIT FORM FOR READING** (1 hour) **SPLIT FORM FOR ARITHMETIC-MATH** (1 hour)	All the above abilities	All the above abilities	The above abilities, except: Creativity with math facts.....DSR	All the above abilities except DMU, and Copying eye-hand and motor integration...NFU	All the above abilities except MSI, and Creativity with math facts.....DSR
CAREER AND VOCATIONS TEST (2½ hours) Age 12 and over	All the above abilities in Forms A & B	All the above abilities in Forms A & B	All the above abilities in Forms A & B	All the above abilities in Forms A & B	All the above abilities except MSI plus MMI

*Based on Guilford's S.I. Theory
**Available in Spanish
***Available in French and Spanish

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The SOI modules and lesson plans are keyed to the Form A and B diagnostic tests and direct the teaching of necessary reasoning and thinking abilities underlying successful performance in reading, math, and science. Sequencing for both three-dimensional and two-dimensional materials is available. Within the "products" dimension, the sequence proceeds from units to implications. Similarly, within the content dimension, the sequence proceeds from Figural to Symbolic to SeMantic. There is reason to believe that nerve pathways are better developed going from right hemisphere to mid to left hemisphere. This strategy is built into the SOI materials.

Conclusion

When students fail in reading or mathematics, what typically happens? They are given more instruction in reading and mathematics, often under the guise of "remediation." This way of treating students in the schools is like treating obese persons by giving them more food.

An excellent example of the lack of growth from such remedial classes is shown in the El Segundo High School Study where after years of remedial work, the 75 students still could not perform because they had never developed the necessary abilities for learning. So long as remediation procedures are targeted to the symptom (failure in reading or in arithmetic), rather than the cause (lack of intellectual skills and thinking competency), then we can predict students will continue their failure to thrive and failure to learn. Rather than focus on remedial instruction, a plan was devised to develop critical intellectual skills in the students attending El Segundo High School. See Table 3 below.

TABLE 3

MASTER PLAN FOR I.E.P.'S EL SEGUNDO HIGH SCHOOL

PERCENTAGES BELOW 16%ile		CURRICULUM	SUGGESTED TIME
	FOR GENERAL ABILITIES		
65%	Low ability to recall details (MFU)	Memory Handbook I	Daily 20 minutes
34%	Low ability to concentration visual stimuli (MSU-A)	Memory Handbook II	Until both books are completed then repeat.
91%	Low ability to sequence visual curriculum (MSS)		
	FOR READING		
90%	Poor visual closure (CFU)	CFU Module	One lesson a day until completed. Repeat if necessary.
75%	Poor visual conceptualization (CFC)	CFC Module	Begin CFC daily after CFU is completed.
80%	Low ability for judging similarities (EFU)	EFU Module	Daily 20 minutes after CFU.
75%	Low ability for verbal conceptualization	CMC Module	Daily 20 minutes after EFU.
100%	Unable to read for word recognition with expected speed (NST)		After completion of CFU, EFU then Speed Reading
	FOR ARITHMETIC		
65%	Low ability to do rote fact (CSS)		Regular classroom instruction
75%	Low ability to do abstract thinking (CSR) Low skills for correct procedure for using facts (ESS) Low skills for complex arithmetic problem solving (NSS)		
75% & 78%	Show low spatial abilities (CFS and CFT)	CFS/CFT Puzzle Math (spatial orientation)	
	Logic and decision making	NSI Module (should be ready next fall)	

We must identify abilities that students who do not learn are lacking and teach those abilities instead of continually failing the students. Most of the problems we see today stem from an invalid assumption about education: that education is not the training of intellectual reasoning competency. A theory which explains abilities to learn also allows us to make the conceptual leap that intellectual reasoning can be taught. Each problem described in this paper has been and can be greatly ameliorated when teachers are trained in the use of SOI theory to restructure the basic curriculum to fit individual learners. The training includes practical issues facing the classroom teacher. For example, Table 4 suggests how one can group students who are designated at the 16th percentile or lower on general abilities for learning.

TABLE 4

HOW TO GROUP FOR SOI ABILITIES TEACHING

The Computer lists rosters of students by number (only 15 are shown here) so that teachers can select from their sourcebooks those exercises where an "S" occurs. These students are specifically below the 16th percentile.

The Class Roster for Arithmetic Grouping

CMU	CMR	CMS	MFU	NST	CFS	CFT	CSR	CSS	MSU	MSS	MSI	ESC	ESS	NSS	NSI	NFU	ID-#
S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	---	1
S	S	S	---	S	S	S	---	S	S	S	S	S	S	S	S	---	2
S	S	S	S	S	S	S	S	S	---	S	S	S	S	S	S	---	3
S	S	S	S	S	---	S	S	S	---	S	---	S	S	S	S	---	4
S	S	S	---	S	S	---	S	---	---	S	S	S	---	S	---	---	5
S	S	S	S	S	S	S	S	---	---	---	S	S	S	---	S	---	6
S	S	S	---	S	---	S	---	S	---	S	S	S	S	S	S	---	7
S	S	S	S	S	S	S	S	S	---	S	---	S	S	S	---	---	8
S	S	S	S	S	S	S	---	S	S	S	S	S	S	S	---	---	9
S	S	S	S	S	S	S	---	---	S	S	S	S	S	S	S	---	10
S	---	S	---	S	S	---	---	S	---	S	S	S	S	S	---	---	11
S	S	S	---	S	S	---	S	S	---	---	---	S	S	S	S	---	12
S	---	S	S	S	S	---	S	S	---	S	---	S	S	S	S	---	13
S	S	S	S	S	S	S	S	S	---	S	---	S	S	S	S	---	14
S	S	S	---	S	---	S	S	---	---	S	---	S	S	S	S	---	15

Note: As the Roster indicates, these 15 students have long standing deficits. The remainder showed similar deficits. They need group teaching except in MSU-Auditory where they need individualized work for so few.

S = Specific Skill Remediation (16%ile and below)

At the end of this school year these students will be posttested to see how effective the training has been.

The Class Roster for Reading Grouping

CFU	CFC	MSU	MSS	EFU	EFC	CMU	CMR	CMS	MFU	NST	ID-#
S	S	---	S	S	S	S	S	S	S	S	1
S	S	S	S	S	S	S	S	S	---	S	2
S	S	---	S	---	S	S	S	S	S	S	3
S	S	---	S	S	S	S	S	S	S	S	4
S	S	---	---	---	S	S	S	S	---	S	5
S	---	---	---	S	S	S	S	S	S	S	6
---	S	---	S	S	---	S	S	S	---	S	7
S	S	---	S	S	S	S	S	S	S	S	8
S	S	---	S	S	---	S	S	S	S	S	9
S	---	---	S	S	---	S	S	S	S	S	10
S	---	---	S	S	S	S	---	S	---	S	11
S	S	---	---	S	---	S	S	S	---	S	12
S	S	---	---	S	S	S	---	S	S	S	13
S	---	---	S	S	S	S	S	S	S	S	14
S	S	---	S	S	S	S	S	S	---	S	15

CONCLUSION:

The first part of this study reported on high school graduates in CETA programs. They had long standing deficits in learning abilities which had never been diagnosed or remediated. The second part of the study reports on students still in school who show a similar absence of learning abilities. These students, however, will have the benefit of SOI training before they are graduated from high school. They will then be post-tested and a vocational analysis made giving them twelve vocations from which to select for investigation.

A two-century old design for curriculum and a normal school approach to training teachers will not prepare students for today's technology and tomorrow's problems. Scholars and educators who have used SOI materials have solved many of the problems discussed in this paper.*

Additional Readings

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* Names of districts available upon request.

STRATEGIC REASONING

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Educators have long realized that major advances in education begin with sound educational theory, but unless that theory can be translated into practical teaching materials, broad application and transfer cannot take place. The Strategic Reasoning system is not only based on sound research and theory but also provides a practical approach to the implementation of thinking instruction in the regular classroom. In particular, all student and teacher materials necessary for the conscious application and transfer of thinking skills to all areas of problem-solving and academic learning are included for immediate use; no teacher-designed materials are required; strong staff development is available, but extensive training is not required; and detailed teacher guides and expanded answer keys are included. Program objectives are as follows:

1. To identify six basic thinking and reasoning techniques which can be applied and transferred to all types of problem-solving and academic learning.
2. To improve and increase the student's ability to utilize the six skills in high order problem-solving.
3. To increase the student's ability to verbalize the thinking process.
4. To provide practice and training for the student in the

conscious application and transfer of the six skills from nonacademic to interdisciplinary subject matter, to real life problem-solving.

5. To improve comprehension of information in all areas and to increase the useful application of that information.
6. To provide a complete system, including all necessary teaching materials, that can be easily transferred from one teacher to another.

Program Design

The Strategic Reasoning system is a cognitive skills-oriented program for teaching the thinking skills, reasoning abilities, and problem-solving processes students must have to function effectively, not only in school but in real life as well. Through Strategic Reasoning, students learn how to process and analyze information so they can make sense of the world, solve problems of all kinds, and meet their personal life goals. The system contains levels of instruction appropriate for students from fourth grade through high school and community college.

The development of students' minds--of their abilities to think, reason, and solve problems--has long been a goal of education. Yet successful means of achieving this goal are unavailable to most educators especially at the secondary level. The problem seems to be one of finding appropriate techniques and materials that enable the systematic teaching of thinking to be efficiently integrated with regular academic instruction. Traditional classroom efforts to develop students' thinking abilities have

typically taken two forms: the exercise of mental abilities with "brain-teaser" activities and increased intensity of subject matter instruction. The brainteaser does exercise the mind, but provides no structure for transferring thinking abilities to other areas. Thinking done in these exercises risks becoming only a game instead of a functional skill; learning that does occur tends to remain isolated from academic performance and from problems, decisions, and other applications in life. Accelerated subject matter instruction, on the other hand, is often based on the assumption that broader knowledge "naturally" causes the mind to develop on its own. While this may be valid for some few students, experienced teachers will confirm that this is not true for the majority. Research for some time has indicated that if we want students to think better, we can best succeed by explicitly teaching them to do so (Bloom and Broder, 1950; Hunt, 1964; Sternberg, 1975; Vallett, 1978).

What is needed is a pragmatic classroom approach--methods and materials--that will systematically develop students' thinking and reasoning abilities in a "pure" sense and directly build the conscious application and transfer of these abilities to academic learning and real life behavior. The Strategic Reasoning system is designed to provide this two-prong thrust to developing students' cognitive abilities.

Strategic Reasoning is based on the hypothesis that deliberate cognitive development can be taught to all students. The system's methodology for fulfilling this goal--the strategy of Strategic Reasoning--is grounded in the research and writing of Dr. Albert Upton, Professor Emeritus of Whittier College. Dr. Upton's work (described below) has

shown that through formalized education, training, and exercise in the use of six basic mental processes with emphasis on the verbalization of these thinking processes, students can be taught to become better reasoners and problem solvers. In addition, they can learn to generalize, that is, to transfer their improved thinking abilities to any situation involving intellectual functioning, including all areas of academic learning and real-life behavior (Upton, 1961; Upton and Samson, 1963; Brunelle, 1967).

A major strength of the Upton/Strategic Reasoning methodology lies in its synthesis of several proven, discrete, successful cognitive development strategies into a complete approach. For example, the work of such diverse researchers as Gordon (1961), Inhelder and Piaget (1958), Levi (1965), Levinson (1965), and Osborn (1963) supports various individual components of the methodology. Recently, Whimbey (1975, 1980) has confirmed the value of conscious verbalization of thinking processes.

Dr. Upton's Research

For over 20 years, Dr. Upton researched the role of "conscious thinking" in learning tasks involving information processing, language comprehension and usage, problem-solving, and creativity. He was concerned with how we consciously use our minds in these tasks. This research (Upton, 1961) produced two main findings:

1. There exists a small set of six primary, natural "thinking skills" which underlie all forms of thinking and problem-solving; and

2. Although these six thinking skills are natural processes in that every individual has the capacity to perform them, one's ability to best use them productively depends on experience and training.

In other words, "better" thinkers have had greater experience and training in consciously using these skills than have "poorer" thinkers.

An obvious implication of these findings is the following: if individuals can be taught to use these basic thinking skills more consciously and are given practice in using them and verbalizing their usage, their overall thinking and problem-solving ability should improve.

In 1960, Dr. Upton tested this implication by designing a cognitive development course which came to be called "Graded Exercises in Analysis." The objectives of this course were to make students consciously aware that they use a small set of six basic skills when they think; to improve students' ability to perform each of the six basic thinking skills; to enhance students' verbalization of each of the six thinking skills; and to increase students' ability to use the set of six thinking skills as a whole model for processing information and solving problems.

The course was taught by Upton and graduate-student assistants to 280 college freshmen over an eight-month period. A standardized intelligence test was used as the pre- and post-measure of students' overall thinking ability. The results were impressive: the average IQ score for the group increased by 10.5 points, with some students gaining 20 points and one gaining 32 points (Hechinger, 1960).

Upton had demonstrated that his methodology for developing cognitive abilities and problem-solving skills were effective. By identifying and developing students' abilities with respect to six basic thinking skills, students can be taught to think better and to solve problems more effectively.

The Six Thinking Skills

Upton's research experience identified a set of six basic thinking skills which underlie all forms of thinking and problem-solving, regardless of the subject material dealt with. Results obtained from the "Graded Exercises in Analysis" course suggested that training in these six thinking skills results in overall improvements in mental performance. Strategic Reasoning is directly designed to train students in these six thinking skills and in the conscious application and transfer of these skills to academic learning and real-life problem solving. The six thinking skills are defined below and illustrations of each are provided.

1. Qualification: The skill of identifying the characteristics (properties) of something. For example: identifying that a pen is six inches long, cylindrical, smooth, and easily held; that the United States is democratic, civilized, large, etc.

   The better we describe the characteristics of something, the better we comprehend it, can fit it to a purpose, can compare it to other things, and can try to change or improve it.

2. Classification: The skill of sorting things into groups

according to shared characteristics. For example: classifying a pen with a pencil and a typewriter as "writing instruments"; the United States with England and France as "western nations."

The better we can classify, the better we can organize data, form concepts, and perform syllogistic reasoning.

3. Structure Analysis: The skill of identifying part-whole relationships. For example: identifying that a chair is a structure physically composed of and defined by a seat, back, two arms, and four legs; that a dry cell has chambers, a zinc electrode, a copper electrode.

   Competently identifying part-whole relationships enhances our comprehension of the composition of things, allows us to analyze key ingredients, and builds spatial reasoning skill (map, chart, diagram, graph interpretation).

4. Operation Analysis: The skill of sequencing things, events, or thoughts into their proper order. For example: sequencing four people from tallest to shortest; planning the steps of an experiment.

   The better we can identify correct sequences, the better we can comprehend serial relationships of all types, follow the steps of any process, and make plans and predictions.

5. Seeing Analogies: The skill of recognizing similar relationships. For example: recognizing that a writer uses a pen

as an artist uses a paintbrush; that Vietnam was to the United States what Angola is to Cuba.

This skill provides the basis for much problem-solving insight, for comprehending metaphors, and for understanding ratio and proportion.

6. Thing-Making: The skill of cognizing things and identifying them with a name, symbol, or mental image. For example: identifying that a place where you store money is called a "bank," as in the side of a river; and that a skull-and-crossbones is the symbol for "danger."

This skill is the basis for vocabulary development, context inferencing, and all communication because it embodies word-reference, knowledge, and associations.

These six thinking skills are the basic elements of all thinking, learning, and problem-solving. "Poor" thinkers perform them poorly; "good" thinkers perform them well. Upton's work concluded that by training students to perform these six skills better, they will become better thinkers and problem solvers.

Strategic Reasoning uses the Upton methodology to develop and improve students' cognitive abilities and to build students' skills in using these abilities to learn and to function in academic and real-life settings. Specifically, the methodology includes four stages of "thinking instruction." The four stages, the broad objective of each, and the Strategic Reasoning materials that are part of each stage are outlined below.

STAGE 1

Objective

To introduce and identify the six basic thinking skills.

The first stage in improving students' abilities to think and reason more effectively focuses on making them conscious of the fact that they do think, that their thinking involves the systematic use of six basic thinking skills, and that they can learn to think better. This is accomplished by using the following materials and strategies.

Components and Strategies

A kit entitled Introducing Thinking Skills and an accompanying Thinking Skill Poster Set comprise the materials used in this stage. The Introducing Thinking Skills kit is a multimedia program (two filmstrips, two cassettes) consisting of eight units.

Each unit is designed to take approximately one class period, with supplemental activities included for teachers wanting to expand students' study of these units. Through the eight units, the teacher guides the students to an awareness that they use six key thinking skills when they solve problems. Students explore samples of how these skills affect their everyday thinking.

The Teacher's Manual contained in the kit includes all lesson plans for completing this section of the system. The activities of each unit are teacher directed, with whole class participation. The activities are brief in duration, inductive/exploratory in nature, and oriented toward group discussion. The activities are designed to provide vehicles that are readily adaptable to students at all levels of learning ability

and to draw upon the creative thinking talents of students and teachers alike.

STAGE 2

Objective

To increase student proficiency in the use of the six thinking skills.

This second stage improves students' ability to apply each of the six thinking skills to a wide variety of nonacademic problems. Students start with easy exercises, proceed to moderate, and end with difficult problems.

Sample Exercises

NON-ACADEMIC EXERCISES: "Seeing Analogies" Thinking Skill

Components and Strategies

In Stage 2, students begin with a skillbook of nonacademic exercises, labeled EASY, and can proceed later to two other such skillbooks labeled MEDIUM and DIFFICULT. There is a detailed Teacher's Guide, including an expanded solution key, for each of these skillbooks.

Each skillbook requires about 6-10 hours of study. In each skillbook, the students solve approximately 100 carefully sequenced nonacademic exercises, such as those shown above. Through their individual work and

a teacher-guided group discussion, the students systematically improve their ability to use the six thinking skills to interpret information and solve problems.

An oral group discussion of all exercises is a key element in this training-of-thinking process. There are several reasons for this. First, the results of Upton's research indicated that students think better and more clearly when they put their thinking into spoken words. Second, many of the exercises are divergent in nature, allowing for more than one "correct" answer. Group discussion allows students to share their answers and reasoning with one another. Third, students often learn more about problem-solving styles and strategies from their peers than from the teacher. Finally, when a student's answer is incorrect, asking that student to explain his or her reasoning will oftentimes result in "hearing" the mistake in reasoning and lead to a self-correcting solution. These factors are key to students thinking improvement.

A most unusual innovation in cognitive development programs is the introduction of the Strategic Reasoning expanded answer key included in the Teacher's Guide. Unlike most other answer keys, this guide provides the teacher not only with the "correct" or "most appropriate" answer for each exercise but also with the following information as well:

. The specific thinking skill required to resolve the problem.

. The "correct" or "most appropriate" answer.

. The rationale supporting that answer.

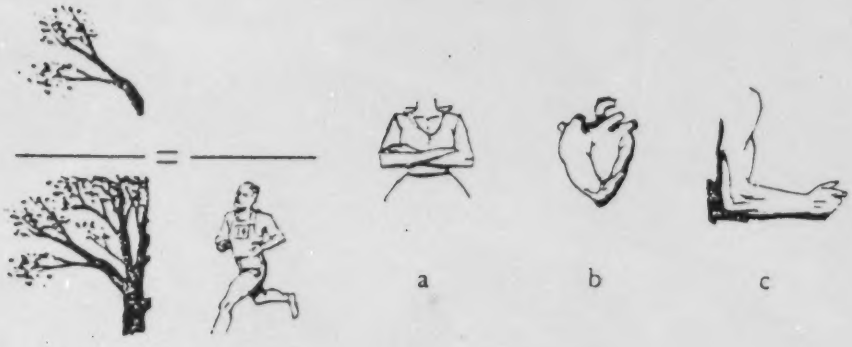
. Possible alternative answers.

. The rationale supporting these answers.

. The reason one answer is more appropriate than the other.

The following is a sample exercise from the expanded answer key:

11. Which drawing (a, b, or c) goes in the blank space?



Seeing Analogies

c. The branch is a piece (limb) that projects from the trunk or body of a tree just as an arm is a piece (limb) that projects from the body of a man.
RELATING FACTOR: is a piece (limb) that projects from the.

Students could choose "b" as an answer using the relating factor of is a part of, but careful analysis would indicate that the branch is an external part that projects from the tree while a heart is an internal part of a man.

Point out to students how "limb" applies to both branches and arms. Ask students what could replace the branch if the analogy was written with the heart at the top right. (eg. pulp or heartwood)

More answer key pages for the teacher exist than exercise pages for the student. This is, obviously, a total reversal of normal procedure. The result is a reduction in the fear of teaching a thinking skills program and the encouragement of teacher-student interaction and verbalization of the thinking process.

STAGE 3

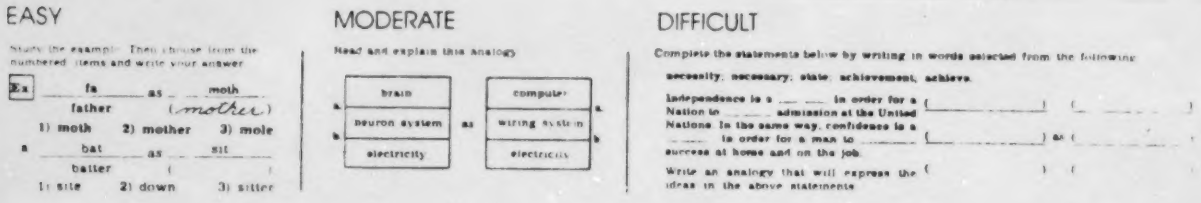
Objective

To provide students with training in the conscious application and transfer of the six thinking skills to learning and comprehension of academic material to "regular" schoolwork.

This stage entails approximately 15-20 classroom hours.

Because conscious application and transfer of thinking skills does not seem to be intuitive or automatic in many cases and because it is generally impossible to rely upon the teacher to develop necessary materials, Strategic Reasoning has created a series of exercises drawn from a variety of academic disciplines (e.g., history, science, English, and math) that integrates content in the subject areas with the six thinking skills. Transfer is clearly indicated and applied to increasingly complex material.

Sample Exercises


EASY
Ex fa as moth
father (mother)
1) moth 2) mother 3) mole
a bat as sit
batter ( )
1) site 2) down 3) sitter
MODERATE
Read and explain this analogy
a brain
b neuron system as wiring system
electricity electricity
computer
DIFFICULT
Complete the statements below by writing in words selected from the following:
necessity, necessary, state, achievement, achieve.
Independence is a ___ ___ in order for a Nation to ___ ___ admission at the United Nations. In the same way, confidence is a ___ ___ in order for a man to ___ ___ success at home and on the job.
Write an analogy that will express the idea in the above statements.

Components and Strategies

Students study an appropriate level academic skillbook determined by the average reading level of students. (Note: six difficulty levels of skillbook are available, numbered 4-9.) The skillbook contains five units of academic-content-based thinking skill instruction. (The sample

exercises shown above illustrate the range of content difficulty that spans the six available skillbooks.) Each unit consists of a short written selection followed by a set of exercises labeled "Logic and Comprehension." The written selections have been carefully chosen to represent a variety of subject matter areas. The "Logic and Comprehension" exercises are thinking skills exercises and problems designed to build students' abilities to analyze, comprehend, and learn the information presented in the selection. Through these units, students will develop their ability to apply their improved thinking skills to their regular coursework.

STAGE 4

Objective

To provide students with training in conscious application and transfer of the six thinking skills to resolving real-life problems.

The ultimate role of all education is to improve the quality of an individual's life, that is, to make that individual successful in the real world and not merely able to survive. The Strategic Reasoning system makes sure that the student is provided with training in the conscious application and transfer of the six thinking skills to problems of varying nature that affect his or her everyday life. Thus, Stage 4 becomes the culmination of all other learning developed in the previous three stages.

This stage involves the use of one of the three multimedia instructional kits outlined below. Each kit deals with a single major social or emotional problem and includes important concepts that challenge

our lives each day.

Components and Strategies

Kit #1 - "2087 A.D."

Theme: Identity

The loss of identity in a world that treats the individual as a computer entry: we are known by a social security number, student I.D. number, etc. We talk to and are instructed by machines. We struggle for a personality in an increasingly impersonal world.

Kit #2 - "Bug-Off"

Theme: Rivalry

Rivalry affects all our actions in business, in school, in our social lives. Rivalry is a concept that is built into our system and must be dealt with in order for us to be successful.

Kit #3 - "Ballot Bunch"

Theme: Prejudice

Unfortunately, this theme exists all around us in a variety of forms: color, sex, age, handicaps. It must be examined and understood if it is to be eliminated.

Strategies

Each of these kits is a multimedia, whole-class learning experience. It gives students the chance to consciously apply their thinking skills to an unstructured, real-life situation.

In each case, a real-life problem situation is posed on audio tape, in dramatic radio show fashion, that students must analyze and solve. Included in each kit is a set of "artifacts" (letters, photos, etc.).

These items relate directly to the problems uncovered in the story. A series of cassette tapes, a Mini-Quiz, and a Teacher's Guide containing lesson plans complete the kit.

The procedure for working through each kit follows a guided-discovery design. Students examine the artifacts and listen to the tapes in order to identify the problem. Then, through a set of questions contained in the Teacher's Guide, they must use their thinking skills to make sense of the situation, interpret character personalities, motives, goals, etc., and finally, form hypotheses for resolving the problem.

With each solution, the students must identify which of the six thinking skills were used to reach a conclusion. The Teacher's Guide identifies the approprate skills required to ensure that thinking becomes a conscious, controllable skill.

SUMMARY OF THE FOUR STAGES OF "STRATEGIC REASONING"

SIX THINKING SKILLS STAGE 1	NON-ACADEMIC STAGE 2	ACADEMIC TRANSFER STAGE 3	REAL-LIFE TRANSFER STAGE 4
Identification of the six thinking skills	Development of student proficiency in applying thinking skills to non-academic exercises.	Training in the CONSCIOUS APPLICATION and TRANSFER of thinking skills to inter-disciplinary subject matter.	Training in the CONSCIOUS APPLICATION and TRANSFER of thinking skills to real-life problem situations.
COMPONENTS	COMPONENTS	COMPONENTS	COMPONENTS
Introducing Thinking Skills Kit Thinking Skills Poster Set	Teacher's Guides Non-academic Student Skillbooks - Levels EASY, MEDIUM, DIFFICULT	Teacher's Guides Academic Student Skillbooks - Levels 4,5,6,7,8,9	3 multimedia kits dealing with separate real-life themes: . Identity . Rivalry . Prejudice

Results

The four stages of thinking instruction and training in the Strategic Reasoning system provide a full program of cognitive development, suitable for a broad spectrum of classrooms.

Strategic Reasoning's effectiveness is demonstrated in a wealth of test data such as the following:

- Orin Glick (1975), director of program evaluation for the Franklin Pierce Schools in Tacoma, Washington, reports that nine of ten instructional groups scored gains in IQ, measured by the verbal and non-verbal intelligence sub-tests of the Short Form Test of Academic Aptitude.
- In District 16, Brooklyn, New York, assessment by District Superintendent Adolph Dembo (1977) revealed pre-post data that indicated ninth grade students on an average gained two full years more than expected in reading comprehension.
- Barbara Spear, et al. (1976) report that an Orange Coast College student population having IQ's lower than 94 attained increases on the Peabody Individual Achievement Test.
- In a study by Raul Besteiro (1980), Superintendent of the Brownsville Independent School District in Texas, below average junior high students achieved a mean gain five times their expected gain on the SRA Achievement Series in Reading.
- Significantly, Laura D. Harckham (1979), independent evaluator for the New Rochelle School District in New York, has conducted

a longitudinal study assessing the effectiveness of continued study by the same students over three successive school years. Below average seventh-grade students successively studying the system in their seventh, eighth, and ninth grade school years achieved mean gains on the Iowa Sub-tests in both Vocabulary and Comprehension two and one-half times their expected gains for that period.

Summary

By means of the careful, guided instruction in thinking provided in the sequence of cognitive exercises in Strategic Reasoning, students will strain their mental muscles much in the same way that a weightlifter strains his body muscles to achieve the goal of increased strength. What might this increased strength do for a learner? Evidence indicates that when students learn the methods of thinking, they develop greater self-confidence and an improved self-image. Also they are more motivated to apply themselves to solving problems and learning, and they become more successful at doing both. And finally, they discover that most subject areas, problems, and goals can be mastered or achieved.

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THE DIRECT TEACHING OF THINKING AS A SKILL

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I believe that the teaching of thinking skills may be one of the major educational trends of the next twenty years. It may even be the most important trend. The teaching of thinking skills is an area full of misapprehensions, misconceptions, mistakes, and misses. In these pages, I will set down in as clear and as solid a manner as I can the outcome of over fifteen years experience in the teaching of thinking across a wide range of cultures, ages, and abilities: from gifted children in Canada to senior public servants in Nigeria; from ten-year olds in Venezuela to senior executives of some of the largest corporations in the world. I also have experience in designing and running what is now the most widely used Program in the world for the direct teaching of thinking as a skill. This Program is in use in England, Eire, Canada, USA, Venezuela, Nigeria, Israel, Australia, New Zealand, Malta, and other countries. I shall describe the basic principles of this Program and the basis for its design, and I shall also explain why I believe, that for structural and other reasons, the USA may lag behind in this area.

Why should we teach thinking? Why is it not being done? How can it be done? What effect would it have? These are some of the questions I want to answer.

Why Teach Thinking?

Thinking is the ultimate human resource--even though only one

government in the world has formally recognized this so far. Some of the relative industrial decline in the USA can be attributed to faulty thinking habits as I shall describe later. A democracy can only work properly if people exercise their minds as well as their votes. In an ever-changing world where fixed guidelines and routine channels no longer operate, the burden of choice and decision requires thinking. In order to cope with the pressures of opportunities, as well as problems, we have to think a great deal. Computer technology increases, rather than decreases, the need for human thinking. All these are powerful reasons for an increased emphasis on the teaching of thinking. But none will make it happen in the future any more than such reasons have made it happen in the past.

In the "13th Annual Gallup Poll of the Public's Attitude Toward the Public Schools"(sponsored in 1982 by Phi Delta Kappa), 59 percent of those polled felt that not enough attention was being paid to teaching students how to think. This finding was no surprise to me, for George Gallup had told me some time ago that his polls always showed something of this sort. I believe that there will be increasing public demand for the teaching of thinking. The thinking demanded will be "wisdom," not just more cleverness and more facts. Thinking will be demanded as a "life-skill" not just a way of passing tests and examinations. There will be pressure put on education to service society in this fashion instead of playing a game unto itself. All this may have some effect on the teaching of thinking.

What will have the greatest effect is not all these real needs and

pressures but the simple realization that it can be done. The idea of software for the mind will suddenly become obvious. It will be realized that thinking can be taught as a skill. In thousands of schools, thinking is already being taught as a skill. There is, of course, much more to it than someone sitting down and putting together a program by picking bits from here and bits from there.

Why We Do Not Teach Thinking

The teaching of thinking as a skill seems so obvious and so sensible that we must ask why it is not done more often. Two direct answers are that it is being done the whole time or that it cannot be done. This is where the misconceptions come in. I shall deal with each of them in turn.

The Diffusion Fallacy: "A student uses his or her mind when studying history or geography, science, or mathematics. Is this not thinking? Is this not thinking practice? Are we not teaching thinking the whole time?" Every teacher would claim to teach his or her subject "in a thinking manner" and would claim to get the students "to think about things." Many such claims would be correct. "Thinking" is such a general word that we can rightfully claim to be thinking when we play chess, mend a puncture, place a bet on the horses, or talk about the football game. All this is very different from a generalizable skill of thinking that can be used deliberately as a skill: assessing priorities, making decisions, setting objectives. This sort of thinking is not taught along with the teaching of the usual academic subjects. In any case, there is the difficulty of transfer which I shall discuss later. We can usually "make a case" that almost any activity is indeed teaching thinking skills. For example, we

can make a case that the chess player has to use strategic thinking, planning, and consideration of alternatives. All this is true. But does that chess player exhibit those skills in everyday life? For reasons I shall explain later, this does not seem to happen. We need to teach thinking directly as a skill. That someone is using thinking at any moment does not mean that the person is developing a transferable thinking skill.

The Intelligence Fallacy: This may be the most dangerous fallacy in education. Thinking is seen to be no more than intelligence in action. Two conclusions can be drawn from this: for people with high intelligence, nothing need be done about their thinking; for people with more humble intelligence, nothing can be done. The result is that nothing is done. In real life, we find that people with high intelligence are not necessarily effective thinkers; in fact, they may be less effective than others. We have come to call this the "intelligence trap." There are many aspects of this (some sociological, some psychological, some physiological) and I shall give but one example here. An intelligent, articulate person will construct a coherent support for an initial point of view. The better that support the less the thinker sees any need actually to explore the subject. So the thinker is trapped in a perception solely because he or she can justify this.

In general, I find the motor car analogy useful. Innate intelligence (genetic, biochemical, early environment, etc.) is the engineering and horsepower of the car. Thinking is the skill with which the car is driven. A high-powered car may be driven badly, and a more humble car may be

driven well.

The implications of the intelligence trap are serious for two reasons. First, we feel there is no need to teach thinking. Second, many brilliant minds are wasted in the "intelligence trap." It is for this reason that the leading school for the gifted in Canada has been teaching thinking skills directly for the last four years.

The Information Fallacy: By definition, God cannot think. A perfect state of knowledge precludes the movement from one state of knowledge to a better one. There probably are some situations in which we can obtain perfect information and so do away with the need to think. It would be an absurd ambition of education to presume to supply so much information that thinking becomes unnecessary. Yet we continue to teach more and more information for some very good reasons: every little bit helps; it is easy to teach and assess; it is there. On this basis we could occupy every available educational minute. So, at some point, there has to be a decision to teach less information and develop thinking skills instead. Obvious as that decision might be in theory, it is very hard to make in practice at any particular point in the curriculum.

The Embedded Fallacy: This is the notion that there is no such thing as a general, transferable skill of thinking. There may be a thinking skill involved in carrying out an historical analysis; there may be a thinking skill involved in doing a crossword puzzle; there may be a thinking skill involved in writing a computer program; there may be a thinking skill involved in mathematics; but all these thinking skills are embedded in that particular area and have to be learned for that area.

The fallacy seems to reflect no more than our past inability to teach generalizable thinking skills. Skills which need to be learned for specific situations do not exclude a generalized thinking skill that may have to be supplemented with the local skill required in that situation. It can be noted that the "embedded fallacy" is the exact opposite of the "diffusion fallacy."

Strongly held as these fallacies may be, they are also vulnerable. It is not difficult to concede that some thinking skills are taught along with other subjects. It is not difficult to concede that some intelligent people may be better thinkers than others less intelligent. But it is only necessary to demonstrate a much more effective way of teaching thinking skills directly in order to demolish these fallacies. These fallacies are based on the fact that we have not attempted to teach thinking directly as a skill and have then gone on to claim that it cannot be done.

What Kind of Thinking?

Thinking is a life skill. Thinking skills are to be used outside school and after leaving school as well as in school. We need to be very clear about this point. Thinking is the most fundamental life skill that can be taught in education. To teach only those thinking skills that are going to be useful for passing tests or for doing better at curriculum subjects would be to negate the whole purpose of teaching thinking. I want to focus here on the sort of thinking that is not normally taught in school.

Operacy: I coined the word "operacy" some time ago. Education is

about the past: reviewing and sorting available knowledge. As soon as a youngster leaves school he or she has to deal with the future. All decisions, plans, choices, and iniatives are going to be worked out in the future. The word "operacy" covers the skills required in getting things done and making things happen. I believe that operacy should rank alongside literacy and numeracy as a prime aim of education. We need to pay attention to the thinking involved in operacy.

Wisdom: As I mentioned earlier, we tend to teach cleverness and facts in school. Our concept of "giftedness" is a student who is good at both these things. We assume that wisdom only comes with age and experience. I believe that wisdom can be taught as a style of thinking. It is the broad, perceptual style of thinking that is what we are trying to achieve in the CoRT Program: taking all factors into consideration; looking at consequences; assessing priorities; taking other people into account. We are, perhaps, too obsessed with cleverness in education.

Projective Thinking: We tend to prefer reactive thinking. We like to be given a problem to react to. We like to be given data to sort out. Gifted children have their minds stretched by being given difficult problems. They become good at such problems, but poor at solving simple problems where the thinker has to generate the context and information. This is the "Everest effect," for the thinker gets used to tackling a difficult problem that is in front of him. In projective thinking, we have to find problems, not just solve them. In projective thinking, we

go out to make things happen. We do not sit back and wait for the data to be put on the table in front of us. The industrial dangers of reactive problem-solving have been mentioned earlier.

Open Problems: An executive rarely has more than 30 percent of the information he needs for making a decision. This is because he or she is dealing with the future, and there is much uncertainty about that. In school, we are used to having all the information we need to solve a problem. In fact, many older children have come to expect the information to do their thinking for them. Society often demands action in areas where we do not have complete information. I know from many talks with business executives that there is considerable dissatisfaction with the thinking skills developed in education at the moment. There is a strong feeling that education only prepares people for the academic world--that it is an end unto itself. Unless a deliberate effort is made, I cannot see any way in which education can come to deliver the thinking skills needed beyond school.

The Importance of Perception

Most thinking takes place in the perception stage. Only very rarely and in very special circumstances is complex logical progression or mathematical processing required. As computers come to take over more and more of our second stage thinking, the burden will fall even more heavily on the first stage, the perception stage. Perception covers how we see the world at the moment. We see it, of course, in terms of the experience map we have built up in the past. So perception involves finding the right "maps" and reading them.

There are two very important aspects of perception:

1. How broadly and how clearly we can see things.
2. How we can see things in different ways.

Both these aspects are covered in the CoRT Program. The first aspect is the broad "scanning" aspect. The second aspect is the "lateral thinking" aspect. "Lateral thinking" is a term I invented many years ago to cover the ability to switch from one perceptual pattern to another.

The System Basis of Perception

In order to write software for a system, you need to know how that system works. In order to design thinking skills programs, we need to know the information system characteristics of how the mind works. Underneath the simple CoRT tools, there is an understanding of how perception works. The teacher of the tools and the student user of tools do not need to know this any more than the driver of a car needs to know how the engine works. But the designer does need to know. That is why this section is perhaps the most important section of this paper. Far too many people sit down to write thinking skills programs without any understanding of how the mind works. Even the much used "information processing model" is a description, not an understanding.

We need to understand the difference between "passive information systems" and "active information systems." In an active information system, the information alters the surface which then alters the way information is received. The surface really provides an environment in which incoming information can organize itself into patterns. A huge difference exists between our traditional passive information systems

and active systems. A number of implications arise from consideration of the behavior of such systems. Insight, hindsight, humor, lateral thinking all arise from the natural behavior of such systems. The CoRT tools are based directly on a consideration of such behavior.

Usually thinking is no more than drifting along the patterns wafted by emotion. We follow one idea until it triggers another, and then we follow that and so on. We call this "point to point thinking."

For example, twenty-four groups of youngsters (aged 10-12) in the Inner London Education Authority schools were asked to consider the proposition "that bread, fish, and milk be free." Some of the groups came from very deprived backgrounds. Twenty-three of the twenty-four groups decided it was a bad idea. Their thinking was typical "point to point" thinking.

"...if these things were free, everyone would want them

...the shops would be crowded

...the buses going to the shops would be crowded

...the drivers would want more money

...they would not get it and would go on strike

...everyone else would go on strike

...therefore it is a bad idea."

CoRT Tool Design

Our perceptual thinking follows the perceptual patterns laid down by experience, in the point to point manner indicated above. We cannot stand back to survey the whole map because we cannot do this through an effort of will. We need to create another layer of patterns, a sort of

super pattern. Technically this has become known as "meta-cognition." We can now switch from the experience pattern layer to the "tool" pattern layer. In this way, attention can be directed to other parts of the experience map.

Our experience is full of "descriptive" concepts or patterns: table, chair, house, insult, etc. The CoRT tools are "operative" concepts which lead us to do things (e.g., look at the alternatives here; assess priorities here). For such concepts to exist, they have to be given a concrete identity. So we create a deliberately artifical identity. For example, someone can be asked to "do a APC" (Alternatives, Possibilities, Choices). The APC is now a defined tool and using it is a defined task. This is quite different from a general exhortation "to look for alternatives."

Most thinkers, at all levels, use their thinking to back up a perception they hold. The PMI is an instruction to oneself, or to others, to carry out a task: look first at the Plus points, then at the Minus points, and finally at the Interesting points. The thinker now uses his thinking to carry out this "task." The thinker has been forced to explore the subject. One girl of 13 put it very neatly. She said, "At first I thought it was very artificial to do a PMI because I knew what I thought. Then I started putting things down under 'P' and 'M' and 'I.' I found myself reacting to what I had put down. In the end, I had completely changed my idea about the matter." Something thought cannot be unthought. The PMI is performed as a scanning task. What is seen is then reacted to. This is why I call it the spectacles method.

Things are not as simple as they seem. The PMI is simple enough to use and very effective. Into this apparently simple tool have gone many considerations. For example, it is a "scanning" tool, not an evaluation tool. That is why it is quite different from the "pro and con" approach, which it superficially resembles. (The "I" or Interest part is also very important.) To list all the points and then sort them into boxes marked "P," "M," or "I" is not the same thing at all: it is judgment not scanning. One consultant told me he had taken the method and modified it to put "P," "M," and "I" across the page and then went across putting a point under each. Again this is not the same thing because we suspect that the brain chemicals are actually different when we are "looking" in the "P" direction from what they are when we are looking in the "M" direction. In tackling the suggestion "that all cars be painted yellow," one boy offered as a Plus point that they would probably be kept cleaner. Another boy offered this as a Minus point because "he had to clean his Dad's car." Both were correct because scanning is subjective: it is the view you see from where you are standing.

To be usable a system has to be simple in the end. Unfortunately, this gives rise to the danger of those who see only the simplicity and wish to change or modify the process without any understanding of what has gone into the design. To use a tool as it is intended you do not need to understand the background considerations. To alter or modify a tool you need fully to understand what is going on.

The CoRT Method

I shall list here the key elements of the CoRT method.

Focus: It is extremely important that in each lesson the teacher focus directly on the purpose of that lesson. The teacher should focus on the tool being practiced and not bring in other aspects of thinking. Confusion must be avoided at all costs.

Perception: The emphasis is strongly on the perceptual stage of thinking. If we have a good view of the situation, we can find our way around and react appropriately.

Operacy: The thinking skills are designed as life-skills, for example, looking at values, other people's views, etc. Many of them are also of use in dealing with school work, for example, the assessment of evidence, creative techniques, etc.

Tools and Tasks: The thinker carries out a specific task: the use of a particular tool. The thinker then reacts to the outcome of that task performance. This takes the ego out of thinking. Instead of "this is clever me thinking about the subject" we have, "this is clever me performing this thinking task superbly well."

Practice: Skill in the use of a tool is obtained solely through the practice of that tool. Philosophical discussion and explanation are kept out of it. Indeed, physical education teachers have often been excellent at teaching CoRT Thinking because they know how to teach skills: practice, fast pace, focus, do it right.

Short Items: The practice items are explained in one or two lines. There is no load of information to absorb or to substitute for thinking. Each item is thought about for a very short time, from two minutes to four minutes. At first both teachers and students find this awkward because

they want to get their teeth into something and have a discussion. Quite soon they acquire the idiom, and it becomes surprising how much can be thought about in this short time.

Variety: There is a wide mixture of practice items from the humorous to the serious. This mixture is very important because the only constant is the tool being practiced. Teachers tend to want to consider only the "heavy" and solemn problems (should kids smoke, career choice, etc.) in the belief that this is what matters in the end. There must, however, be a mixture of problems and practice items because there is often better thinking practice on remote items. When the tool has been mastered, then it can be switched to the "backyard items."

An important aspect of the CoRT teaching style is what might be called "teaching from the center." This is in contrast to the usual "teaching from the boundary." Teaching from the boundary means defining things by defining the boundary (Is it this, or that?) with a discriminating question. This is the method of philosophy. Teaching from the center means showing what is required by strong and pure examples. Grey areas are acknowledged as grey areas and then ignored. If something is to be included under "A" and again under "B," it does not matter at all in the skill areas, just as you might direct a ball to the far corner of the court with either a top spin or sliced backhand.

The students work in groups of four or five. In several schools, one of the prime reasons for using the CoRT Program is that it provides the only area in the whole curriculum where students work in groups. Groups allow more thinking and talking time. In an open class situation,

the same "bright" students will always volunteer the suggestions and the rest will take no part at all. In a group, those who are not very active can listen to the thinking immediately around them.

The report back or feedback stage is important. There are no "right" and "wrong" answers. The teacher is not the custodian of the book of knowledge. Yet the teacher has to acknowledge each idea or comment in a way that gives it value. Teachers who are used to teaching open ended subjects develop a repertoire of responses. In fact, in some teacher training colleges, the CoRT Program is used specifically to give teachers experience in handling such subjects. There are various styles of accepting feedback (one point from each group; groups in turn; points from individuals; listing of points, etc.). As much variety as possible should be put into this aspect because although feedback is vital for motivation, it can take up a long time and is less interesting to the students who are not as interested in the ideas of others as in their own.

The thinking lessons need to be run at a brisk pace. If one particular practice item is not going well, then the teacher moves on to the next one. The key words are lively, focused, and crisp, and there is the idiom of CoRT teaching. Many of the teachers who use the CoRT Program have not had specific teacher training for logistical reasons, but where training is available, it is recommended because the training focuses on the CoRT style and teaching idiom.

Thinking skills are basic and that is why the same material can be used with elementary school children and executives. The CoRT Program has been used across the age range from six-year olds to adults, and

across the ability range of IQ 80 to 140. From the more able students, more is demanded. With younger children, things must be simplified. On the whole, it has been our consistent experience that teachers underestimate the ability of younger students to think. Teachers who have known their students over two years are suddenly astonished at the thinking shown by these same students in the CoRT Thinking lessons.

The CoRT Program

The Program is divided into six sections. Each section focuses on one aspect of thinking and contains ten individual lessons. All ten lessons are related to a single objective which is indicated in the section title.

CoRT I. Breadth

This section is concerned with tools and habits for scanning widely around a situation. It contains the following individual lessons: Treatment of ideas (PMI); Factors involved (CAF); Rules, drawing together the first two lessons; Consequences (C&S); Objectives (AGO); Planning, drawing together previous lessons; Priorities (FIP); Alternatives (APC); Decisions, drawing together previous lessons; Viewpoint (OPV).

CoRT II. Organization

This section is concerned with teaching students how to be organized and systematic in a thinking situation. It contains the following individual lessons: Recognize; Analyze; Compare; Select: Find other ways; Start; Organize; Focus; Consolidate; Conclude.

CoRT III. Interaction

This section is concerned with the thinking that involves other

parties. It contains the following individual lessons: Examination of both sides (EBS); Type of evidence; Value of evidence; Structure of evidence; Agreement, Disagreement, Irrevelance (ADI); Being right 1.; Being right 2.; Being wrong 1.; Being wrong 2.; Outcome.

CoRT IV. Creativity

This section is concerned with creativity, lateral thinking, and design. It contains the following individual lessons: Yes, No, and Po; Stepping stones; Random input; Concept challenge; Dominant idea; Define the problem; Remove the faults; Combination; Requirements; Evaluation.

CoRT V. Information and Feeling

This section is concerned with the place of information and feeling in thinking. It contains the following individual lessons: Information (FI-FO); Questions (FQ & SQ); Clues; Contradiction; Guessing; Belief; Ready-mades; Emotions and ego; Values; Simplification and clarification.

CoRT VI. Action

This section provides an action plan or structure for drawing together the previous lessons into a set of stages for effective thinking. It can, however, also be used independently of other sections. There are both verbal and graphic codes for the structure. It contains the following individual lessons: Target; Expand; Contract; Target-Expand-Contract (TEC); Purpose; Input; Solutions; Choice; Operation; Over-all structure (TEC-PISCO).

The material is deliberately designed in a "parallel" fashion so that each lesson can stand on its own. CoRT I should be done in all cases because it provides basic tools that can be used later. There is,

however, no need to work steadily through each of the sections. Some schools use CoRT I and CoRT VI. Others use CoRT I, CoRT IV, and CoRT V. For the Venezuelan project, I devised a special program consisting of the "tool" lessons in CoRT I and thirteen lessons from other CoRT sections.

With older students, where there is time and a proper commitment to the teaching of thinking, the full two-year program can be used. One lesson a week is advised. This can, however, be split into two periods. Each lesson can be done in 35 minutes but this is rushing things. A double period is perfect. Project work is provided for those schools where it is the custom to give students projects to work out on their own.

The Effects of Teaching Thinking as a Skill

Four levels of effects can be identified.

Level One: There is a change of self-image. Instead of the alternative images: "I am intelligent" (and do well at school and please the teacher) or, "I am not intelligent" (and school is a bore), we get a new self-image: "I am a thinker." This change is powerful because the "intelligent" self-image is a value image; whereas "I am a thinker" is an "operating" image and therefore responds to interest and practice ("I can get better as a thinker.").

This sort of self-image change can have a strong effect on behavior. At the Hungerford Guidance Centre in London, which takes delinquent and violent students from other schools, the principal, David Lane, started using the CoRT Program and developed in the youngsters a pride in their thinking. As a result, instead of responding to situations with the

usual violent stereotypes, the youngsters were able to stand back, pause, and think objectively about their situation.

Because the CoRT Thinking lessons do not depend on the reading and writing "gate," we have found that many children regarded as backward suddenly turn out to be very good at thinking, to the amazement of their teachers and peers. The resulting boost in confidence can spill over into their reading and writing scores. It is a sobering thought to reflect how many "good thinkers" are currently being wasted by the education system because there is no way of allowing them to emerge and show their ability.

When students who have done thinking lessons in elementary school go on to high school, the teachers there often comment that the students seem different: they seem more mature; they are more willing to listen to others; they get on with things.

Level Two: A paper by John Edwards and Richard Baldauf from James Cook University (Australia) suggests that students who were taught less science and some CoRT Thinking instead did better at their science examinations. When I was making the ten-part TV series for the BBC, some of the children in the audience seemed outstanding in their thinking, out-thinking the executives who were also in the audience. Everyone supposed these children to be gifted. They were not. In each case that we traced back, we found that these children had come from schools that were using the CoRT Program. At level two, we would expect an actual difference in thinking performance. This would be shown by greater balance in thinking: a willingness to look for alternatives; a greater

than usual consideration of the consequences of an action; taking other people into account. And although no specific use existed of the CoRT tools (and these might not even be remembered), the general effects of the different tools would be apparent. Thinkers would be more inclined to step back and carry out thinking "tasks" ("what are the priorities here?") instead of using point-t--point thinking.

Level Three: At this level, there would be specific use of some of the tools, for example, PMI. Children might use these tools at home or get their parents to use them. From the New York School of Thinking come many examples of how adults used the tools to solve business and personal problems. The tools give detachment and focus. One thinker described how conscious use of the tools kept him sane during highly incompetent medical care in a New York hospital. At this stage, students find that they can switch into a sort of role playing, the role being that of a CoRT Thinker. The thinker then watches his thinking performance in this role. There is a most interesting point here: if you play act being intelligent, will you really become intelligent? The answer must be "no." But if you play act being a thinker, will that make you a thinker? The surprising answer is probably "yes." Play acting at being a thinker may well make you a thinker. The artificiality of some of the CoRT tools (for example, codes such as PMI and C&S) actually become an advantage here because they allow a conscious and deliberate switch to the "thinking role."

Level Four: Here we have a thinker who would have all the tools and processes at his or her finger tips. The thinker would be able to

"program" his thinking as someone might program a computer. One stage would follow another, and the output of one stage would be fed into another stage. The thinker would be skilled at all the processses: detached, competent, and fluent. I do not expect level four to be achieved often--if ever. That does not matter because you can head North without any hope or even desire of reaching the North Pole.

Evaluation

This is an important area fraught with dangers and misconceptions. Let me say at once that no adequate measuring tool exists for assessing the effects of the teaching of thinking skills. The only proper test would be to follow youngsters who had been taught thinking skills through school and after. It would be necessary to observe both day-to-day thinking activity and also thinking within their chosen career.

If you are setting out to teach mathematics in a new way, then it is clearly up to you to show statistical proof that your way is better than the existing way. You would do this by using our current tests of mathematics if you claim to achieve better results on such tests. The consideration of a new subject area such as thinking skills (in its broad sense) is a different matter.

I see the evaluation levels as follows.

1. Feasibility: This is the most important of all. Can the ordinary teachers handle it? Is it teachable across a range of cultures and abilities? How do the students respond? What happens in the lessons? Can teachers be trained? If a program or subject area requires an inspired and highly trained teacher with a heavy one-on-one relationship

to each student, then clearly it is not feasible. What happens with 30 unruly students on a Monday morning? It may take years of experience to establish this practical feasibility. CoRT after ten years has only just completed this stage. Further, the huge Venezuelan project where CoRT is used in every conceivable educational situation is providing evaluation of this sort.

2. Observation: This is the soft data area. What happens to the students? What do they say? What do parents say? What do teachers say? What do employers say? What changes are there in behavior? Are there any detectable changes? Are the changes harmful? Are the changes related to skills or attitudes? Where do the changes manifest themselves? What are the negative effects? How long do the changes last? With regard to the CoRT Program, we have been accumulating data of this sort. Much of it, however, is still locked up in the minds of those who have had experience in the teaching of CoRT. Not all data can be extracted by a questionnaire.

3. Hard Data: This is the area of measurement and statistical assessment. We are right to demand and be impressed by statistics, but statistics are worse than useless without the proper measuring tools. They can damage and distort a subject especially when used by those who do not understand their weaknesses. It has, in the past, been our policy at the Cognitive Research Trust to encourage users of the CoRT Program to carry out their own research. We have a number of such studies carried out by local users, often without the rigorous treatment we would prefer. Papers such as that by Edwards and Baldauf are beginning to

appear and this is a trend we want to encourage. The design and the measuring instruments must, however, be appropriate.

I want to contrast the above schedule of evaluation with the more typical model. In this typical model, the program designer sets up a test in one or two highly motivated local schools. Everything is properly controlled and the results seem impressive. Note that this sort of test is done under highly artificial conditions and by the design team itself. There is no experience, no test of feasibility under different conditions, no allowance for teacher variation, and no allowance for the Hawthorne effect.

The Future

As regards practical steps for the introduction of thinking skills into education, we come at once to some important but difficult points. The first one is a dilemma and a typical Catch-22. It goes as follows:

For practical purposes it would be much easier to introduce thinking skills through an existing subject area, but if we do this, it will negate the effectiveness of teaching thinking directly as a skill.

We could put it another way:

Thinking should be taught as a distinct subject in its own right, but if this is insisted upon, it may never get taught at all.

To understand why it is important that thinking be taught as a distinct subject, the reader ought to go back to three parts of this paper: the problem of transfer as discussed in the section on the traditional approaches to the teaching of thinking; the nature of perception and the CoRT method; and the level one effects. Of particular

importance are the level one effects which will only happen if thinking is taught as a separate subject and content free.

How far does the ideal have to compromise with the practical? Quite far, but if the compromise destroys the very essence of what is being sought then, by definition, that compromise is pointless.

There are usually no gaps in the curriculum. There are usually no blank spaces and free-floating individuals waiting to become "thinking teachers." In practice, CoRT Thinking has been taught by a variety of teachers, ranging from English teachers to music teachers and physical education teachers. The subject area of English is perhaps the most natural home if there cannot be a special subject area of "thinking." This is because language and thinking go together. The teaching style is also open ended: there is less subject-content demand than in science or mathematics.

Even though the CoRT Program might, for practical reasons, be taught in a particular subject area, it should be kept pure. It should be taught directly as "thinking." Once this has been done, then bridges and applications to a specific subject area may be made. Ultimately, I would like to see thinking skills taught as a subject in its own right while at the same time the skills are being diffused into the separate subject areas.

The next point has largely been covered in the preceding point. Should thinking be content free? I have definite views about this. I

believe that unless thinking skills are taught in this manner then they will never be acquired as skills of general applicability. There is another Catch-22 here. If thinking skills are attached to a content area, the subject will make much more headway, but it will be a much less effective subject.

In a climate of "back to basics" and "accountability," it must seem unlikely that a new subject such as thinking would ever get accepted. On closer examination, however, this may be the right climate. Thinking after all, is the most basic of all skills.

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